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(54) High frequency RF identificaton system using low frequency RF/ID chip

(57) A high frequency RF identification system (20) comprises a passive identification tag (11) and an ID code reader (14) for querying the identification tag (11) and processing the ID code derived from the identification tag (11) to provide information relating to the item that is to be monitored. The tag (11) comprises an RF transponder (12) for storing an ID code relating to the item and an excitation coil (13) coupled to the transponder (12). A forward conducting diode (21) and a capacitor (22) are coupled to the excitation coil (13). The ID code reader (14) comprises an exciter (15) and an RF excitation coil 16 coupled to exciter (15). The reader (14) includes an RF receiver (17), an RF receiver coil (18) coupled to the an RF receiver (17), and a forward conducting diode (23) and a capacitor (24) coupled to the receiver coil (18). The RF carrier frequency generated by the exciter (14) is increased to a relatively high frequency (27 MHz, for example). The transponder chip (12) is clocked at a relatively low frequency (125 KHz, for example), in synchronism with a clock signal derived at the reader (14). Thus, the present system (20) operates at a relatively high RF carrier frequency, while using a transponder chip (12) that operates at a relatively low operating frequency.

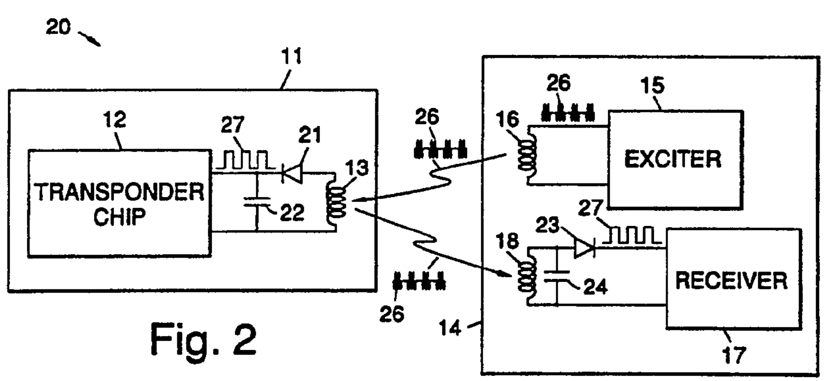

Fig. 2

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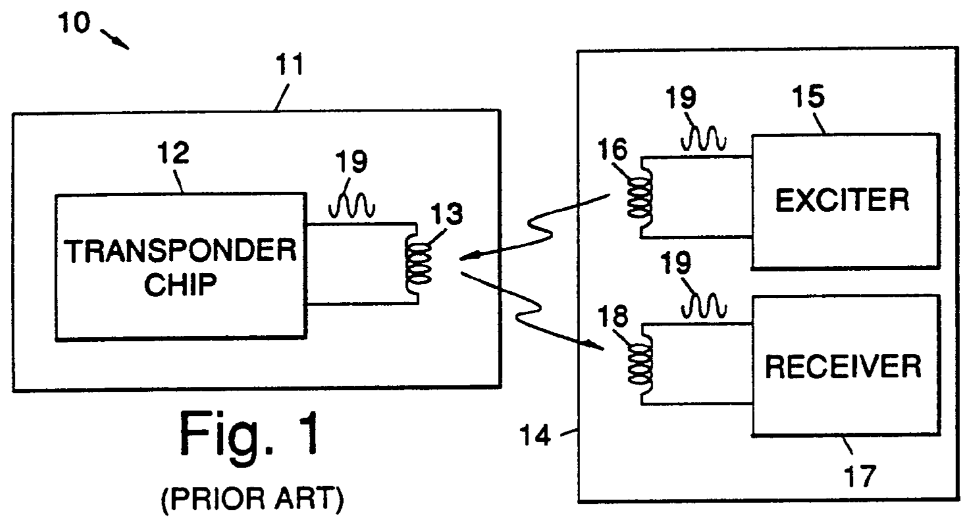


Fig. 1

(PRIOR ART)

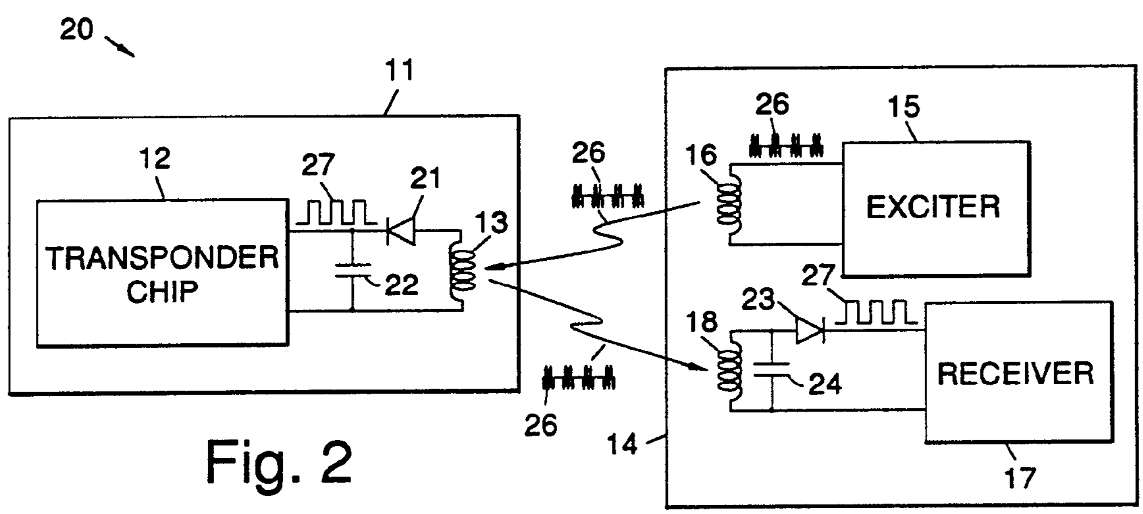
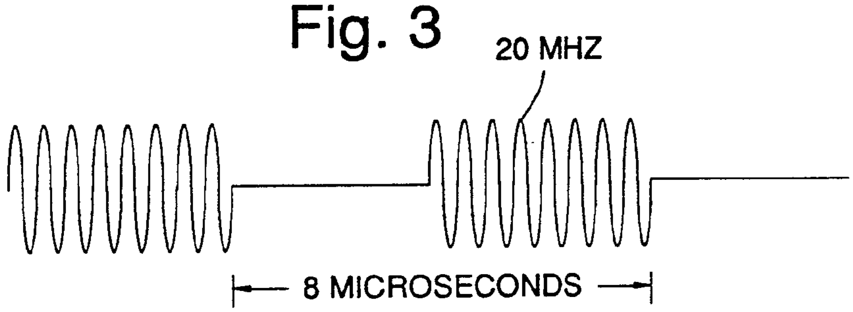


Fig. 2

Fig. 3



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HIGH FREQUENCY RF IDENTIFICATION SYSTEM USING A LOW FREQUENCY RF/ID CHIP

BACKGROUND

The present invention relates generally to identification systems, and more particularly, to a high frequency RF identification system using a low frequency RF/ID transponder chip.

Identification systems have been demonstrated that attempt to use a low frequency RF/ID transponder chip for high frequency applications. For example, this problem has been solved using local oscillators on-board the transponder chip that operate at a suitable relatively low frequency. These oscillators are inherently unstable, and as a result, it is not possible to use a highly tuned detection circuit to detect the presence or absence of any frequency returned from a queried ID tag that that has a frequency related to the operating frequency of the oscillators. In addition it is not possible to coherently detect the return signals because the phase relationships of the signals are not known.

Therefore, it is an objective of the present invention to provide for a a high frequency RF identification system using a low frequency RF/ID transponder chip that overcomes the above-mentioned problems.

SUMMARY OF THE INVENTION

The present invention is a radio frequency (RF) identification system that includes a passive-type identification tag and an ID code reader. The present invention is adapted for specific use with identification systems and RF/ID tags of the type

manufactured and developed by the assignee of the present invention. The passive-type identification (ID) tag comprises an RF transponder and an antenna and is placed on an item that is to be monitored. The RF transponder contains an ID code and other relevant information or data relating to the item that is to be monitored. The ID code reader comprises an exciter coupled to an RF transmit antenna and a receiver coupled to an RF receive antenna. The ID code reader queries the passive-type identification tag using a transmitted RF signal generated by the exciter. The transponder chip responds to the transmitted RF signal or query from the exciter and an ID code or other data is read out of the transponder chip by way of the RF antenna coupled thereto. The ID code reader receives the ID code and/or data from the transponder chip and processes the information to provide relevant information to a user about the item that is tagged.

The present invention adapts the above system to provide for high frequency operation. To achieve this, the coils coupled to the RF transponder chip and receiver are modified to operate at higher frequencies and include the capacitors and forward conducting diodes. The RF carrier frequency generated by the exciter is increased to a relatively high frequency (27 MHz, for example). The transponder chip is clocked at a relatively low frequency (125 KHz, for example), in synchronism with a clock signal derived at the reader. Thus, the present invention provides an apparatus for using a passive-type RF/ID tag at a high RF carrier frequency, while using a relatively low operating frequency transponder chip.

There are two conflicting requirements for RF/ID tags when choosing an RF operating frequency for use therewith. On the one hand, it is desirable to use a very high operating frequency (1 MHz to many gigahertz) for the carrier frequency to facilitate a simple coil design. On the other hand, it is desirable to clock the transponder chip at a low frequency (100 KHz, for example), to lessen the power dissipation and current draw of the tag. The present invention provides a solution for these two conflicting requirements.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features and advantages of the present invention may be more readily understood with reference to the following detailed description taken in conjunction with the accompanying drawings, wherein like reference numerals designate like structural elements, and in which:

Fig. 1 illustrates a conventional RF identification system employing a passive-type identification tag;

Fig. 2 illustrates an RF identification system in accordance with the principles of the present invention;

Fig. 3 illustrates the carrier frequency and related parameters employed in the RF identification system of Fig. 2.

DETAILED DESCRIPTION

Referring to the drawing figures, Fig. 1 illustrates a conventional RF identification system 10 employing a passive-type identification (ID) tag 11. The RF identification system 10 comprises a passive-type identification tag 11 and an ID code reader 14. The passive-type identification tag 11 comprises an RF transponder 12 and an excitation coil 13 and is placed on an item that is to be monitored (not shown). The excitation coil 13 in the identification tag 11 typically has a large number of turns (about two hundred turns, for example). The RF transponder 12 stores an ID code and other relevant information or data relating to the item that is to be monitored. The transponder chip 12 may be a type 1495 transponder chip manufactured by Hughes Aircraft Company, for example, that is designed and functions as described in U.S. Patent No. 4,730,188 issued to Milheiser. The 1495 transponder chip 12 is shown connected in its normal low frequency mode that operates at a typical carrier frequency of 125 KHz, for example.

The ID code reader 14 comprises an exciter 15 coupled to an RF excitation coil 16 and a receiver 17 coupled to an RF receiver coil 18. The receiver and exciter coils 16, 18 may be combined with a corresponding small loss in performance. The excitation coil 16 coupled to the exciter 15 in the reader 14 typically also has a large number of turns (about two hundred turns, for example). The ID code reader 14 queries the passive-type identification tag 11 using a transmitted RF signal generated by the exciter 14. The transponder chip 12 responds to the transmitted RF signal or query from the exciter 15 and an ID code or other data is read out of the transponder chip 12 by way of the RF excitation coil 13 coupled thereto. The ID code reader 14 receives the ID code and/or data from the transponder chip 12 by way of the RF receiver coil 18 and receiver 17, and processes the information to provide relevant information to a user about the item that is tagged. The exciter 15, transponder chip 12, receiver 17 and the respective excitation and receiver coils 16, 18, 13 used in the conventional RF identification system 10 are designed to process carrier signals 19 that are at a relatively low frequency, typically on the order of 125 KHz.

Referring to Fig. 2, it illustrates an RF identification system 20 in accordance with the principles of the present invention. The identification system 20 is substantially the same as the system 10 shown in Fig. 1 except that a forward conducting diode 21 and capacitor 22 are coupled to the excitation coil 13 of the identification tag 11 and the excitation coil 13 has relatively few turns. In addition, a

forward conducting diode 23 and capacitor 24 are coupled to the receiver coil 18 of the receiver 17 in the reader 14 and the excitation coil 18 has a predetermined number of turns. A carrier signal 26 transmitted by the exciter 15 is substantially higher than in the system 10.

Fig. 2 shows how the 1495 transponder chip 12, for example, may used with a high frequency carrier signal 26 that is transmitted from the exciter 15. The carrier signal 26 is a 27 MHz sine wave, 100% modulated by a 125 KHz carrier frequency. The characteristics of the carrier signal 26 are shown in Fig. 3. The carrier signal 26 has an 8 microsecond period and a 27 MHz carrier frequency.

The forward conducting diode 21 and capacitor 22 coupled to the 1495 transponder chip 12 rectify the 27 MHz carrier signal 26 and present a 125 KHz envelope to input terminals of the 1495 transponder chip 12. The excitation coil 13 may typically have 50 turns in this example. Therefore, the 1495 transponder chip 12 process or sees the exact same signal as it did in the conventional system 10 shown in Fig. 1, and operates exactly the same. In a manner similar to the system 10 of Fig. 1, the transponder 12 transmits a return signal by amplitude modulating the excitation coil 13 with a resistive load through the forward conducting diode 21. However, in the identification system 20 of Fig. 2, the 27 MHz carrier is amplitude modulated with a signal that is phase coherent with the 125 KHz modulation signal.

The receiver coil 18 and receiver 17 of the ID code reader 14 are substantially the same as in the ID code reader 14 of the system 10 shown in Fig. 1, except that the forward conducting diode 23 and capacitor 24 are added to the front end of the receiver 17. The receiver coil 18 may typically have 50 turns in this example. Consequently, the 27 MHz signal received from the identification tag 11 is detected and only the 125 KHz carrier component remains. This 125 KHz carrier component has been amplitude modulated by the data from the 1495 transponder chip in the identification tag 11. The transponder chip 12 is clocked at a relatively low frequency (125 KHz, for example), in synchronism with a clock signal derived at the reader. Thus, the present invention provides an identification system 20 that uses a passive-type RF/ID tag 11 at a high RF carrier frequency, while using a transponder chip 12 that operates at a relatively low operating frequency.

Thus there has been described a new and improved high frequency RF identification system using a low frequency RF/ID transponder chip. It is to be understood that the above-described embodiment is merely illustrative of some of the many specific embodiments which represent applications of the principles of the present invention. Clearly, numerous and other arrangements can be readily devised by those skilled in the art without departing from the scope of the invention.

What is claimed is:

1. An RF identification system (20) characterized by:

a passive-type identification tag (11) characterized by:

an RF transponder (12) for storing an ID code relating to an item that is to be monitored;

an excitation coil (13) coupled to the transponder (12);

a forward conducting diode (21) coupled between the excitation coil (13) and the transponder (12); and

a capacitor (22) coupled across the excitation coil (13); and

an ID code reader (14) for querying the identification tag (11) and for processing the ID code derived from the identification tag (11) to provide information relating to the item that is to be monitored, and wherein the ID code reader (14) is characterized by:

an exciter (15);

an RF excitation coil 16 coupled to exciter (15);

an RF receiver (17);

an RF receiver coil (18) coupled to the an RF receiver (17);

a forward conducting diode (23) coupled between the RF receiver coil (18) and the receiver (17); and

a capacitor (24) coupled across the receiver coil (18).

2. The RF identification system (20) of Claim 1 wherein the excitation coil (13) in the identification tag (11) has a few turns.

3. The RF identification system (20) of Claim 1 wherein the excitation coil (18) coupled to the exciter (15) has a few turns.

4. The RF identification system (20) of Claim 1 wherein the excitation coil (13) in the identification tag (11) has about fifty turns.

5. The RF identification system (20) of Claim 1 wherein the excitation coil (18) coupled to the exciter (15) has about fifty turns.

6. The RF identification system (20) of Claim 1 wherein the receiver and exciter coils (16, 18) are characterized by a single coil.

7. The RF identification system (20) of Claim 1 wherein the exciter (15) generates a carrier signal (26) characterized by a 27 MHz sine wave, 100 percent modulated by a 125 KHz carrier frequency.

8. An RF identification system substantially as hereinbefore described with reference to and as shown in Figures 2 and 3 of the accompanying drawings.

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Patents Act 1977 **Examiner's report to the Comptroller under Section 17** **(T Search report)**	Application number GB 9508579.1
Relevant Technical Fields (i) UK Cl (Ed.N) H4L (LACA-X, LADCS, LADX) (ii) Int Cl (Ed.6) G01S 13/75	Search Examiner MR N HALL Date of completion of Search 15 JUNE 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- 1-8

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	EP 0270274 A2	(MERIDIAN) see Figures 3, 4, 8	1 at least
X	EP 0242906 A1	(NEDAP) see Figures 1, 2	1 at least
X	EP 0011810 A1	(ALSTHOM) see Figures 1, 2	1 at least
X	US 5218343	(STOBBE) see Figure 2	1 at least

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